Herpetology for High School Students

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Abstract:

Because of the long-term nature of this project, students were able to see major changes in land use including clear-cutting and they were able to assess the environmental impacts on various reptiles and amphibians due to human uses of particular areas of the site. Project Description During a week-long residential summer program, high school students were introduced to local species of reptiles and amphibians and engaged in a variety of general population studies including lentie aquatic turtles, box turtles and calling amphibians (i.e. the only amphibians that typically vocalize are male frogs who are calling female frogs to the breeding pools or defining territory).

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Article:

Headnote

Authentic environmental education gives young people opportunities for hands-on field experiences

DURING THE PAST SEVEPvAL DECADES there has been an alarming decline in many amphibian populations worldwide. Even though scientists are making headway in understanding some of these declines, much is still not known about the health of even local amphibian species. What we do know is that amphibians are outstanding bio-indicator species and if their populations are declining it is a signal to us that something has gone awry in the environment: and that should be of concern to all of us.

It has been said, that people will only care about that which they know. Herpetology, the study of reptiles and amphibians (collectively known as 'herps'), excites students of all ages. While some herps are familiar to students, most of what students know about these animals is only from pictures. When they have an opportunity to handle them, their excitement quickly evolves into an interest in the habitats where these animals are found. We have found that even a surface-level knowledge about animal and habitat leads students into complex scientific investigations.

For the past ten years we have conducted herpetology (the study of reptiles and amphibians) programs for K-12 students in the Piedmont region of North Carolina (NC)1. Our high school programs involve students in long-term research studies of box turtles, aquatic turtles, frogs, snakes and salamanders. Our work provides an introduction to reptiles and amphibians, their habitats and stresses the importance of long-term scientific investigations. The purpose of this article is to share the how's and why's of establishing similar programs in other places.

Project Goals

As our participants learn about local species of reptiles and amphibians through direct experiences and become engaged in long-term ecological studies, they grow in their knowledge, skills and dispositions towards science and the environment. Specifically, our goals were to:

1. increase students' knowledge of herpetological science;

2. develop students' competence in collecting, processing, analyzing and communicating scientific data;

3. encourage students' awareness of and appreciation for the local environment;

4. nurture students' interest in and enthusiasm for herpetological fieldwork; and

5. increase students' awareness of careers in science, particularly herpetology and field ecology.

Our intention was for students to gain knowledge and skills in identifying common reptiles and amphibians and to understand the interrelationships among organisms as well as the relationships between animals and various habitats at the research study site. Our study site was a 365-acre environmental education center that operated a long-running church camp with extensive recreational programs. Because of the long-term nature of this project, students were able to see major changes in land use including clear-cutting and they were able to assess the environmental impacts on various reptiles and amphibians due to human uses of particular areas of the site. For example, one popular camp activity for younger children involved using a front loader to move soil and create a big mud hole. Campers enjoyed running and sliding in the mud hole and chasing a huge ball around the mud hole. Gray tree frogs quickly moved into this new mud hole and claimed it as a place to breed and lay eggs. Our students quickly came to realize that human activities and frog life styles are not always compatible. During another summer, large lake toys were erected near turtle basking logs. And, in yet another summer, a timber company logged trees near a number of small vernal pools on a hillside. These changes happened at a site were employees were generally environmentally conscientious and staff had a commitment to environmental stewardship.

Another objective for students was to develop competence in conducting research on population trends for both common species (e.g. Fowler's toads and Spotted Salamanders) as well as less common species (e.g. Eastern Box Turtle which is listed as a species of interest on the NC Wildlife Action Plan). The combination of animal and habitat content knowledge with research skills leads to a better understanding not only of the local environment but also a deeper conceptual understanding related to environmental literacy.

Project Description

During a week-long residential summer program, high school students were introduced to local species of reptiles and amphibians and engaged in a variety of general population studies including lentie aquatic turtles, box turtles and calling amphibians (i.e. the only amphibians that typically vocalize are male frogs who are calling female frogs to the breeding pools or defining territory). Our participants also studied ephemeral pool and deciduous forest ecosystems. At the end of the residential program, students selected one population to continue to study during the follow-up days we held amidst the next academic year and beyond.

In addition, students had an opportunity to meet and work with a number of scientists and were exposed to careers in the biological/ecological field science disciplines. Guest scientists talked about their careers, and gave advice to our participants about the kinds of courses to take in high school and possible college programs to investigate further. They shared their research interests and findings with the students and often accompanied them into the field.

One of the main foci of our program is to increase students' insight into and appreciation for the scientific investigative process. As part of their population studies, students collect data by identifying various species of reptiles and amphibians, distinguishing between males and females, estimating ages, measuring and weighing animals (using calipers and spring scales), marking some animals (using triangular files), and using radio-telemetry to track resident Eastern Box Turtles. Participants gain skills in scientific investigation and methodologies, map reading and map making, using GPS technology, collecting and reporting weather data and entering abiotic and organism data into databases. From these initial population studies, some students suggested more refined investigations including variation in turtle trap placement, bait used in turtle traps, and trap camouflage. As students spent time in our program, their scientific questions became more sophisticated and had a stronger investigative focus.

Some of our scientific studies are more sophisticated than others. For example, we have participated in a statewide project to assess the health of our state reptile, the Eastern Box Turtle, Terr apene carolina carolina. Our snake studies, are still evolving but our investigation of a potential correlation between people's attitudes toward snakes and their estimation of snake length lead to a recent Science & Children publication2. Our frog study models a multi-state project focused on identifying calling amphibians and estimating their populations using a call index. One group of students is currently working with our state museum curator for reptile and amphibian collections to collect missing voucher specimens from the local environment. Voucher specimens are animals that are euthanized that represent absolute proof that they are found in a particular place. These specimens are housed in the NC Museum of Natural Science's collection and can be used for scientific studies.

Each population study is guided by an inquiry question such as "What types of aquatic turtles are found in this lake?" or "What types of salamanders and frogs are using the ephemeral pools?" For the aquatic turtle study we placed between five and eleven baited aquatic turtle hoop traps in a 14-acre lake. We collected larval and adult salamanders and frogs using minnow traps in ephemeral pools. We conducted frog call hikes in the evenings to identify calling amphibians. In the deciduous forest we placed artificial habitat such as pieces of plywood, tin and PVC pipes in 150-meter transects3. Students followed protocols to check traps and artificial cover, carefully

removing animals. They identified each species and then processed the animals, releasing them at the point of capture. Processing included weighing, measuring, marking, sexing, and photographing each organism as well as recording information about environmental parameters such as temperature, precipitation and cloud cover4.

Our box turtle data were shared with scientists conducting a statewide box turtle survey project. Scientists think these populations are declining due to habitat fragmentation but currently there is little evidence to support this supposition. We were interested in the age structure of the box turtle population. Would we have as many young turtles as we did older turtles, (which can live to be one hundred years old)? We were also interested in the home ranges of box turtles of both sexes as we wanted to determine a maximum capacity for box turtles on our study site.

At this time, we have marked nearly 100 box turtles and nearly 200 aquatic turtles. To share their scientific findings with a wider authence, students entered the raw data into our Excel spreadsheets and into online regional databases such as the Carolina Herp Atlas (www.carolinaherpatlas.org).

Throughout the program, our students were engaged in the whole process of science: generating research questions, reading research and talking with others working in the field, struggling with equipment and data collection, interpreting collected data and finally presenting their research project methodologies and findings to others. Students were exposed to careers in the biological/ecological science disciplines and had opportunities to meet and work with a number of scientists. We wanted students to know not only what scientists do and how scientists think, but to gain an awareness of and appreciation for local organisms and habitats. The knowledge, skills and positive dispositions towards the environment are the basis of strong environmental literacy. Our herp program has clearly become a model of authentic environmental education.

Results and Effectiveness

Over the years, our qualitative and quantitative survey data demonstrated that our students had more knowledge about reptiles and amphibians as well as scientific investigative processes after spending a year in our program.

Environmental Education guidelines suggest that high school students should be able to identify animals common to local ecosystems. This is a considerable part of our work. Students learned to identify reptiles and amphibians in different habitats (lake, ephemeral pools, and woodlands) by using classification keys and field guides. Students learned the importance of using multiple indicators to identify an organism. In their small research groups students could often be heard 'debating' with each other about species identification, pointing out color patterns, lengths of tail, and shell shape.

Identifying common organisms is a favorite activity of our students and one of the surprising findings of our research (at least to us) is how many students note that their favorite experience in the program revolves around the fact that these are "real animals in real habitats." One student described her experience this way: "It gave me a different view of science. At school, in textbooks, you see pictures of everything you learn about and maybe read about. But you don't really know what it's like, what it feels like. But out here, you're engulfed in it. You're here for a week. Everything we did is about science. It gives you a different view. . .it's real."

Families also began finding reptiles and amphibians in their own backyards. One parent volunteered in a focus group session, "Sally's particularly interested in snakes .... and we live out in the country so she put up coverboards at home and so she's been catching snakes and she tells us what they are and she's been writing down all this data about them. It's just been a really interesting project for her to take what they did here and then do it at home."

Environmental Education guidelines also suggest that high school students should be able to document changes in land use and the environmental effects on local organisms. A group of students wondered whether or not certain camp activities and levels of activity could impact capture rates of aquatic turtles. While we certainly haven't figured out the causal relationship yet, our students have many hypotheses just waiting to be tested.

For us, one of the highlights of this program has been the authentic environmental education experience and the love of organisms they leave with (or, in the best cases, continue with) and return year after year to study. What we have clearly seen is that our students fall in love with these creatures and their surroundings and that this environmental bond is strong.

Relevance and Implications for other Practitioners

The lessons we learned have implications for other environmental education programs:

1. Investigations need to extend over long periods of time. As students spent more time in the program their inquiries became more investigative as opposed to informational. While students' initial questions were related to naming certain organisms, as they learned more about the organisms and their habitats, they started asking more questions about relationships between organisms, habitats and people.

2. Environmental education that includes scientific research needs to allow students to develop scientific process skills and discipline-specific vocabulary in context. For example, our participants learned to use Pesóla scales to weigh turtles, calipers to take different shell measurements, and GPS units to mark and find locations of box turtles within the context of each research study.

3. For more robust development of students' abilities to create arguments based on evidence, they need to collect the data themselves and spend time wrestling with evidence and explanations.

4. Students need both formal and informal ways to communicate their scientific findings (at state science meetings as well as at community events).

5. You must make time for the things that students themselves most enjoy which is simply appreciating the outdoor experiences and enjoying the animals, holding them, asking questions about them, and taking pictures of themselves with the animals.

Replicating our Herpetology Education Programs

Many of our research projects can be duplicated in a variety of settings. Students can conduct frog call surveys in urban settings with only a thermometer. A local lake or river can be used for aquatic turtle population studies. An aquatic turtle trap costs about $60. The only equipment needed for an ephemeral pool survey are minnow traps (available at local department stores for

about $10 per trap). Partnering with a local, regional or state/provincial park, you might consider conducting a box turtle survey project. If you have a forested area, you can conduct surveys simply by flipping logs or be more methodical and use artificial habitat (plywood, tin and PVC transects). As with any out-of-door activity, care must be taken to prepare students for the inevitable and inherent dangers they might encounter (e.g. poison ivy, ticks or venomous snakes).

Our students demonstrated the value of this informal environmental education experience. They not only learned how to identify common organisms in local ecosystems, they also engaged in long-term population studies for these organisms. They documented changes in land use and contemplated associated environmental effects. All of these experiences helped them develop an awareness and appreciation for the local environment.

Footnote

Endnotes

1 These summer programs were partially funded by a Burroughs-Wellcome Grant from 2007 - 2010, and funded by a NSF ISE Grant # DRL-1 1 14558 in 2012.

2. Scott, C., Tomasek, T. & Matthews, C. (2010). Thinking like a Ssscientist. Science & Children, 48 (1), 38 - 42.

3. Tomasek, T., Matthews, C. & Hall, J. (2005). What's slithering around on your school grounds: Transforming student awareness of reptile and amphibian diversity. American Biology Teacher, 67 (7), 419 - 425.

4 Data sheets for all projects are posted on our website at <http://theherpproject. uncg.edu>.

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